

What is claimed is:

1. A repetitive motion exercise therapy device for rehabilitating one or more limbs of a patient, said device comprising:

a frame configured to support a patient thereon;

at least one limb support assembly supported on said frame which is adapted to support a respective limb of a patient and articulate the limb about one or more limb joints thereof, said limb support including a first upper limb support member pivotally attached to said frame at an upper pivot location disposed proximate a first limb joint, and a second intermediate limb support member pivotally connected to said upper limb support member at a second pivot location disposed proximate an intermediate limb joint, and a third lower limb support member pivotally attached to said intermediate limb support member at a third pivot location proximate a third lower limb joint;

wherein one or more pivot axes extend through each of said first, second and third pivot locations to permit articulation of the joints of the limb about one or more of said pivot axes to effect rehabilitation thereof;

a first drive unit connected to said upper limb support member which pivots said first limb support member about at least one of said pivot axes at said upper limb joint;

a second drive unit connected to said intermediate limb support member to pivot said intermediate limb support member about at least one said pivot axis at said intermediate limb joint;

a third drive unit connected to said lower limb support member to pivot said lower limb support member

about at least one said pivot axis at said lower limb joint; and

a control unit which controls said first, second and third drive units to move said upper, intermediate and lower limb support members through any of said pivot axes to articulate one or more of said limb joints of said limb.

2. The device according to Claim 1, wherein said first, second and third drive units include sensors which detect the operation of said first, second and third drive units to control movement of said first, second and upper, intermediate and lower limb support members.

3. The device according to Claim 2, wherein said control unit includes a microprocessor configured to receive data signals from said sensors and generate command signals for said first, second and third drive units.

4. The device according to Claim 1, wherein said limb is an arm having a shoulder joint, elbow joint and wrist joint, and said limb support assembly is configured to support said arm of the patient, said upper limb support member being adapted to support an upper arm of the patient, said intermediate limb support member being adapted to support the forearm of the patient, and said lower limb support member being adapted to support the wrist and hand of a patient, said pivot axes comprising at least one shoulder axis for the shoulder joint, at least one elbow axis for the elbow joint and at least one wrist axis for the wrist joint.

5. The device according to Claim 4, wherein said lower limb support member includes a hand grip which is movably supported to articulate about at least two said wrist axes, said third drive unit comprising a first wrist motor for moving said hand grip relative to one said wrist axis and a second wrist motor for moving said hand grip relative to another said wrist axis, said control unit operating said first and second wrist motors simultaneously and/or independently of each other.

6. The device according to Claim 1, wherein said control unit includes an operator interface which prompts a device operator for inputs to control a sequence of operation of said first, second and third drive units.

7. The device according to Claim 1, wherein said device comprises two said limb support assemblies adapted to support both arms of a patient, said control unit configured to move said limb support assemblies independently of each other or simultaneously, and to move each said limb support assembly to articulate said upper, intermediate and lower limb support members through multiple sequences of movement about said pivot axes.

8. The device according to Claim 1, wherein said device comprises a swing arm which is pivotally connected to said frame so as to pivot about a vertical axis, said limb support assembly being supported on said swing arm so as to be movable therewith wherein said vertical axis

of said swing arm defines one said pivot axis at said first pivot location for said first limb joint.

9. The device according to Claim 1, wherein said limb support assembly is movable sidewardly relative to said frame to adjust a lateral position of said limb support assembly relative to a patient.

10. A repetitive motion exercise device for articulating the limb joints of a patient undergoing therapy, said device comprising:

a frame having a patient support assembly attached to said frame to support a patient thereon, said frame further including frame members pivotally supported on said frame at respective frame pivot locations and first driver units which are operably connected to said frame members to effect rotation of said frame members;

a limb support assembly mounted respectively on said frame members so as to be movable therewith, said limb support assemblies extending from said frame members and being pivotally secured thereto at respective support pivot locations, second drive units being operably connected to said limb support assemblies to effect movement of said limb support assemblies at said support pivot locations; and

a controller operably connected to said first and second drive units, said controller being configured to operate each said first drive unit to pivot said frame members with respect to said frame about a first pivot axis extending through said frame pivot location and to operate each said second drive unit to pivot said limb support assemblies with respect to said respective frame

members about a second pivot axis extending through said first support pivot location.

11. The device according to Claim 10, wherein each of said limb support assemblies comprises a plurality of limb support sections pivotally attached to each other at respective second pivot attachment points, third drive units being associated with each of said second pivot attachment points to pivot a respective one of said limb support sections about said respective second pivot attachment point; and said controller being operatively connected to said first, second and third drive units to operate said first, second and third drive units to pivot said limb support sections about respective pivot axes extending through said respective pivot attachment points, said support pivot locations and said frame pivot locations.

12. The device according to Claim 11, wherein each said limb support assembly comprises three said limb support sections which are respectively adapted to support the upper arm, forearm and wrist of the limb of a patient.

13. The device according to Claim 12, wherein one of said third drive units is provided for each of said limb support sections to effect pivoting movement of said respective limb support section about one or more pivot axes independently of the other of said limb support sections.

14. The device according to Claim 13, wherein said controller is operatively connected to all of said drive units to independently operate the drive units and effect articulation of the patient's limb about one or more joints thereof and about one or more pivot axes associated with each said joint.

15. A repetitive motion exercise therapy device for rehabilitating a limb of a patient by articulating the limb about a plurality of limb joints associated therewith, said device comprising:

a frame;

at least one limb support assembly supported on said frame, said limb support assembly comprising a plurality of limb support sections which are joined one attached to the other to support multiple sections of a patient's limb along the length of the limb between the limb joints, said limb support sections being joined one to the other by a pivot connection wherein each said pivot connection corresponds to a limb joint, said limb support assembly further including a drive unit associated with each pivot connection to effect articulation of one limb support section relative to an adjacent said limb support section for articulating the limb joint associated therewith; and

a control unit operably connected to the drive units for independently or simultaneously operating said drive units to effect controlled manipulation of the limb support sections about the pivot connections.

16. The device according to Claim 15, wherein said pivot connections correspond to a shoulder joint, an

elbow joint and a wrist joint of a limb and effect articulation about at least one pivot axis for each said limb joint.

17. The device according to Claim 16, wherein said pivot connection associated with said shoulder joint permits movement of an upper one of said limb support section about a plurality of pivot axes.

18. The device according to Claim 17, wherein said shoulder pivot axes comprise a vertical shoulder axis, a horizontal shoulder axis extending forwardly and a longitudinal arm axis extending longitudinally along the length of an upper arm section.

19. The device according to Claim 16, wherein one said limb support section comprises an intermediate limb support section which is pivotally connected to a distal end of said upper arm section and defines a vertical elbow pivot axis.

20. The device according to Claim 19, wherein said limb support section comprises a wrist support section which is pivotally connected to said intermediate support section by the associated pivot connection which said associated pivot connection defines a horizontal pivot axis extending sidewardly and a horizontal pivot axis extending longitudinally along the wrist.